13.4.11. Control of Purple Loosestrife

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Purple loosestrife is an herbaceous perennial weed that is native to Eurasia and probably arrived in eastern North America with early maritime traffic. The spread of this alien by 1900 (Fig. 1) was closely associated with canal and waterway traffic. By 1985 (Fig. 2), this aggressive weed had spread into all of the contiguous States north of the 35th parallel except Montana; similarly, all of the southern provinces of Canada had been invaded. In the last 20 years, loosestrife has become well established in reclamation projects and riparian wetlands in the West and Northwest. It has also invaded estuarine marshes in British Columbia.

The impact of this weed on North American wetland habitats has been disastrous. In many areas, purple loosestrife makes up more than 50% of the biomass of emergent vegetation. Moreover, these displacements are seemingly permanent, as seen in the Northeast, where many purple loosestrife stands have maintained themselves for more than 20 years. The effects of these changes have not been well studied but biologists believe that serious reductions in productivity of waterbirds and aquatic furbearers have resulted. Platformnesting species cannot use the stiff loosestrife stems for nest construction, nor are stems or rootstocks palatable to muskrats. In addition, dense, closely-spaced clumps do not provide brood cover or foraging areas. Although white-tailed deer and livestock will readily graze on young, succulent plants, palatability declines by late June and the forage value of wetland pastures that have been invaded by purple loosestrife is seriously reduced.

Field Identification

Purple loosestrife is most readily identified by its tall, showy spikes of pink-red flowers that bloom from late June to early September. Mature plants can have 30 or more stems arising 6 feet above a perennial rootstock (Fig. 3). With the onset of fall frost, leaves turn red for about 2 weeks; shortly thereafter, they fade and gradually fall. The sturdy, rigid stems remain standing through winter and spring—well into the following growing season. Each stem supports dense, spiralling rows of dark-brown seed capsules that will remain attached to the floral stalks through the winter, creating a distinctive silhouette that is useful in field recognition. From overhead, the brownish tone of each clump of dead stems could make a useful signature in aerial photography.

Adaptations

Most serious weeds are of foreign origin and have evolved competitive mechanisms in their native habitats that preadapt them to be successful on new continents that they may invade. Purple loosestrife is no exception; its affinity for freshwater marshes, open stream margins, and alluvial floodplains in Europe is closely paralled by its invasion of similar sites in North America. Moreover, its most common plant associates in American habitats

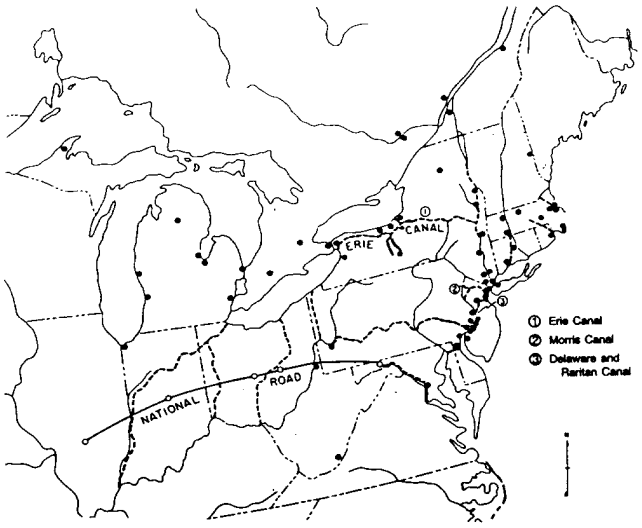

Fig. 1. Spread of purple loosestrife as of 1900.

(cattails, reed canarygrass, sedges, and rushes) are highly similar to its associates in Europe.

The outstanding success of loosestrife in invading American wetlands is supported by a remarkable list of weedy attributes. Purple loosestrife has demonstrated a high degree of resistance to chemical control, indicating that the genetic makeup of our American population is robust. Vigorous and varied modes of reproduction also characterize a successful weed. These traits are demonstrated in prolific seed production that issues from the dense whorls of capsules that are borne on each floral stalk; 3-year-old plants can produce in excess of 1 million seeds. Vegetative reproduction is another competitive advantage; loosestrife can withstand clipping, crushing, or shallow burial by sending up new shoots from adventitious buds arising from stems or rootcrowns (Fig. 4). Purple loosestrife also has a wide scope of seed dispersal mechanisms. The flat, thin-walled seeds are small enough to be carried in the plumage of migrant waterbirds or the fur of aquatic mammals; they have also been recovered from mud caked on the feet of shorebirds. Similarly, seeds trapped in mud on footgear, vehicle treads, or in the cooling systems of outboard motors could account for local and long-distance jumps in the distribution of this weed. Drift in flowing water or by wind on the surface of open water are the most likely means of local spread.

Purple loosestrife has an added advantage over most weeds in that it is cultivated and sold as horticultural stock across the northern United States

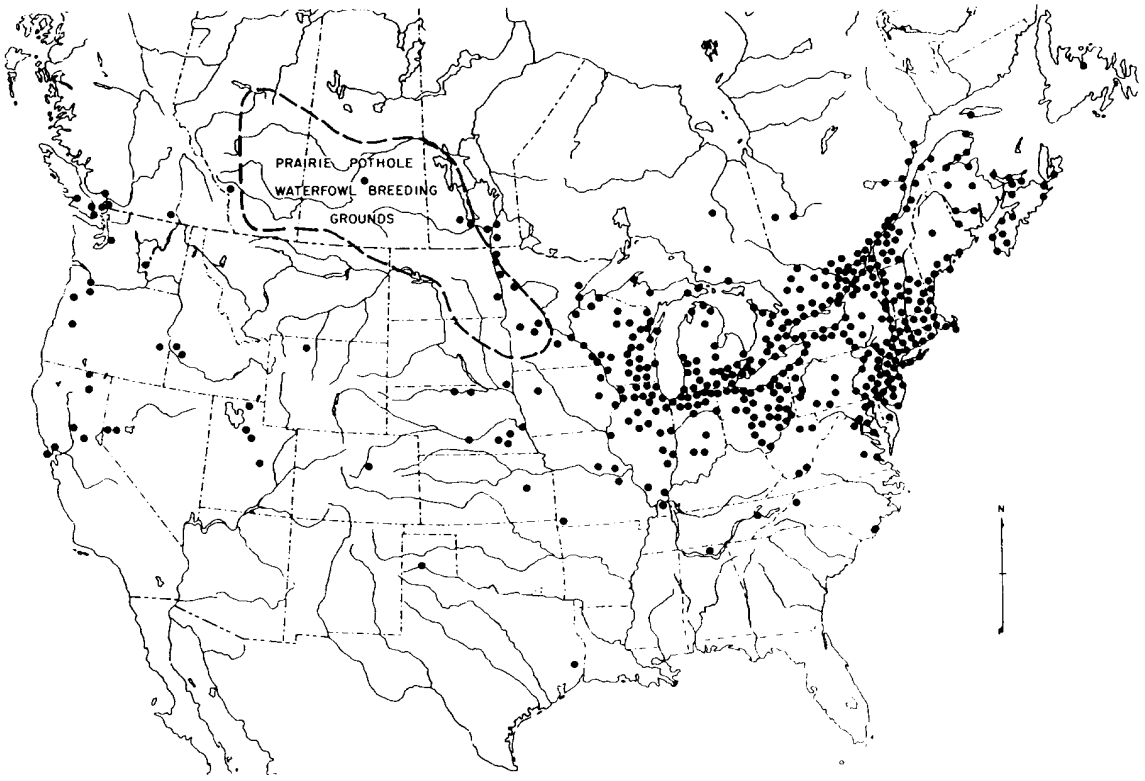

Fig. 2. Distribution of purple loosestrife as of 1985.

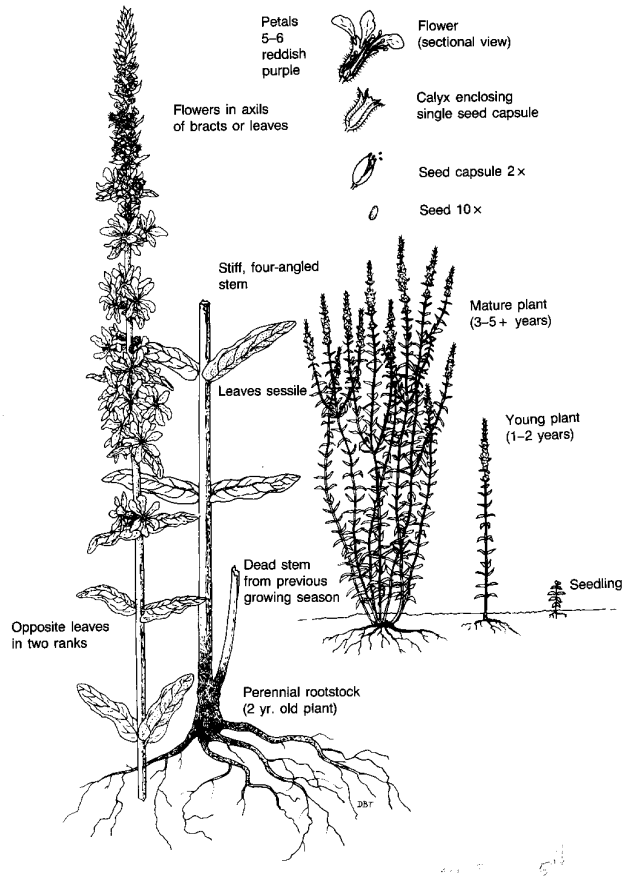

Fig. 3. Structure, growth forms, and field identification of purple loosestrife.

and southern Canada. Most of these stocks are infertile hybrids; however, some local sources include fertile plants that could escape into downstream wetlands. Beekeepers have also been responsible for the spread of purple loosestrife into uninfested wetlands. They value the plant as a source for nectar and pollen and have scattered seed in several midwestern waterways. With growing awareness of the impact of loosestrife on wildlife habitats, this practice is declining.

Another source of escapes arose from a growing interest in the restoration of native vegetation on country acreage. More than 150 private seed companies offer seed mixes of "wildflowers" and native prairie vegetation. A recent survey indicated that about 25% of the lists of seed mixes from these suppliers contained alien species; 10% of the lists containing aliens included purple loosestrife. Anyone attempting to restore a marsh or wet prairie with the faulty mixes would be inviting disaster. Within the past 10 years, Idaho, Illinois, Ohio, Minnesota, and Wisconsin have enacted legislation to check

Fig. 4. Adventitious shoots of purple loosestrife arising from stems that have lodged onto a mat of duckweed (*Lemna* spp.) in a deepwater marsh near Rome, Wisconsin.

the spread of purple loosestrife through seed supplies or horticultural stocks.

Habitat Vulnerability

To protect their resource, wetland managers need to develop a sensitivity to the vulnerability of habitats to purple loosestrife invasion. Since loosestrife spreads primarily by floating seeds or propagules, a marsh basin or pothole that is isolated from surrounding drainage channels is relatively secure from infestation. The configuration and continuity of a river or waterway determines its vulnerability. Mountain or high plateau streams with steep gradients and narrow canyons are relatively invulnerable to loosestrife colonization and spread. In contrast, streams with low gradients and broad floodplains have shallow cross-sections and slow, winding channels that offer many opportunities for colonization by drifting seeds or propagules. Streambank cover is also an important determinant of vulnerability to invasion by an emergent perennial weed. The presence of cattails, grasses, sedges, or rushes (purple loosestrife's most frequent associates in North America) identifies a habitat that is susceptible to invasion. In contrast, streams that are bordered by woody vegetation (riverbottom hardwoods in the East; spruce, willow, and alder in the West) have well-shaded banks where the high light requirement of purple loose-strife precludes seedling development.

Recent Control Efforts

Chemical—Although early efforts to control purple loosestrife with chemicals were discouraging, the advent of glyphosate (Roundup:N-[phosphonomethyl] glycine) brought new promise of success. Designed as a postemergence spray for the control of agricultural weeds, this broad-spectrum herbicide was authorized for field tests on purple loosestrife in upstate New York in 1979. These experiments showed no significant differences among three rates (1.7, 3.4, and 6.7 kg/ha) of application but revealed sharp differences in responses to timing of application; treatments in the 2nd week of August at late flowering stage obtained nearly 100% shoot reduction. This work also showed that seedling survival was affected by the timing of application; the plots sprayed in June became reinfested with seedlings whereas the plots sprayed in July and August were free of seedlings.

In 1982, a new formulation of glyphosate (Rodeo-EPA Reg. No. 524-343) was approved for use over water, thereby clearing glyphosate for field use against purple loosestrife. Rodeo has subsequently been used for loosestrife control in the Northeast and Midwest with some success. Nevertheless, several problems confront the use of glyphosate in natural habitats. First, single applications seldom result in complete control; each summer, a small percentage of purple loosestrife crowns fail to send up shoots and thus avoid mortality. Second, the movement of ATV spray rigs in wetland habitats can cause more damage to the community than control of weed clumps will relieve. Last, although aerial spraying will avoid physical damage to the habitat, the widespread use of a broad-spectrum herbicide on complex wetland communities will have unknown effects on nontarget native species. Field studies in a wide range of habitats have shown that herbicides can affect breeding birds by altering the structure, foliage diversity, and species composition of vegetation treated. The wise use of chemical control in natural habitats hinges on the care with which the treatment is delivered. The delivery system should be as gentle and as target-specific as possible.

Water manipulation—Awareness of the effects of soil and water levels on purple loosestrife is one of the wetland manager's most useful means of coping with the weed. Experimental work in Ohio on the effects of flooding on loosestrife seedlings showed that duration of flooding was more important than depth; mortality in 8-inch seedlings covered by 12 or more inches of water increased sharply after 2 weeks, reached 95% mortality by 4 weeks, and 100% by 5 weeks. Seedlings with terminal growths extending above the water surface grew vigorously and survived flooding.

Mowing and tillage—Along irrigation canal banks or other rights-of-way where tractors can operate, repeated mowing or clipping will greatly reduce the vigor of purple loosestrife. A combination of spraying with a broad-leaf herbicide and subsequent repeated mowing will encourage monocot competitors; with grasses reestablished, the cover can be more easily maintained. These efforts will also suppress a potential source of loosestrife seeds from migrating down the canal. Loosestrife's woody rootstock is the key to its vulnerability to tillage. As an herbaceous perennial, it stores energy in its root crown which lies in the upper 6 inches of the soil. Tillage with disc or harrow is an effective means of grubbing loosestrife rootstalks from fallow fields or open borders where disturbance to the soil or plant community is acceptable. To suppress adventitious shoots arising from broken rootstocks, spot spraying with an herbicide will probably be needed—followed by seeding with native grasses or reed canarygrass.

Other measures—Another way to suppress loosestrife seedlings is to sow Japanese millet on muck beds exposed by an early drawdown. In addition to suppressing loosestrife seedlings, mature emergent millet stands can provide high-quality waterfowl food. This technique would be particularly useful on small areas that are accessible for hand seeding, e.g., waterbird display pools; it would be less useful during drawdowns on large impoundments with scattered emergent stands and many remote muck flats that would be difficult to reach. Plant competition can be used by the wetland manager to slow or even stop the spread of local infestations. Loosestrife seedlings cannot establish or survive in the shade of willow or alder thickets, nor under the canopies of wetland hardwoods. Wetland managers threatened with the invasion of purple loosestrife should be careful not to stress or disturb shrub or tree communities under their care.

Biological Control

Field studies in North America and Europe have identified purple loosestrife as an excellent candidate for biological control. Since 1987, interagency (USDA and USFWS) efforts have been underway for the biological control of purple loosestrife. Thus far, several promising candidate in-

sect control agents have been identified; search and screening for additional agents continue in Europe. Meanwhile, rigorous host specificity tests on a list of cultivated and native plants from North America have begun in Europe on three insect species. Additional screening tests will be performed in quarantine in North America.

Containment

At present, containing the spread of existing infestations is our best strategy. The rate of spread of purple loosestrife between 1940 and 1980 has been estimated to be 1,160 km^2/year (381 mi^2/year). This relatively slow rate of expansion can be further reduced with several countermeasures.

Early detection—Purple loosestrife has several characteristics that can be exploited to slow its spread and impact. First, its tall floral stalks immediately identify an established plant. Second, it is difficult for loosestrife propagules to gain foothold in undisturbed wetland habitat; they need a patch of moist soil that is open to sunlight to establish themselves as seedlings. Last, if an isolated plant somehow becomes established in an otherwise healthy wetland, its seeds will remain dormant and suppressed by surrounding native vegetation—thus giving an alert wetland manager time to eradicate the invader. Managers whose units are within the limits of loosestrife distribution should include an annual search for purple loosestrife in their work schedules. The search need not be highly organized or exclusively pursued, but it is important that it remain among each summer's plans. Annual lowlevel aerial photography can be helpful in maintaining surveillance of loosestrife infestations; scientists in Ohio have constructed infestation maps from 35-mm color transparencies obtained from county Agricultural Stabilization and Conservation Service files.

Local eradication—Wetland managers who are alert to the first appearance of purple loosestrife can successfully follow a program of local eradication. If the infestation occurs as scattered, young plants in soft, organic soil, hand pulling or digging is often feasible; however, since fragments of stem or root crown can regenerate new plants, all pulled material must be carried out of the wetland basin. Wisconsin wetland managers have found that small areas (less than 50 plants), isolated colonies can be eradicated with herbicides delivered from hand-carried sprayers. The herbicide should be applied directly on the weed's foliage. When using glyphosate, great care should be taken to avoid drift onto the weed's nearest neighbors; these plants are needed to close in the space occupied by the dying loosestrife clump. Spraying with glyphosate can be done any time after loosestrife foliage is well developed; however, best results will be obtained with late summer applications. Broadleaf herbicides (2,4-D) are also effective on purple loosestrife; moreover, they offer the advantage of not harming monocots which are loosestrife's most frequent neighbors. Although best results with 2,4-D come from applications in early growth stages (late May to early June), the absence of flower spikes increases the chances that spray crews will overlook some plants. Whatever herbicide is used, the infestation sites should be revisited later in the season, and in subsequent years, to be sure that all loosestrife survivors are eradicated.

Minimum impact management—Until a biological control program can be implemented, the key to coping with established purple loosestrife is to avoid any manipulations or actions that might stress the native vegetation and allow loosestrife seedlings to spring up from dormant seed stocks. The standard waterfowl management practice of early drawdown to encourage smartweed and millet seedlings on shallow impoundment margins is an open invitation to purple loosestrife dominance. Shallow reflooding to provide dabbling duck foraging will often not be sufficiently deep to suppress young loosestrife seedlings. If a drawdown cannot be avoided (for example, a water control structure needs repair), the work should be delayed until mid-July. By this time, the peak of the growing season will have passed and loosestrife seedlings will not have sufficient time to grow to a size that would survive reflooding and overwinter dormancy.

Suggested Reading

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Appendix. Common and Scientific Names of Plants and Animals Named in Text.

Plants

Alder	*Alnus* sp.
Sedge	*Carex* sp.
Japanese millet	*Echinochloa crusgalli*
Rush	*Juncus* sp.
Duckweed	*Lemna* sp.
Purple loosestrife	*Lythrum salicaria*
Reed canarygrass	*Phalaris arundinacea*
Spruce	*Picea* sp.
Smartweed	*Polygonum* sp.
Willow	*Salix* sp.
Cattail	*Typha* sp.

Animals

White-tailed deer	*Odocoileus virginianus*
Muskrat	*Ondatra zibethicus*

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